IN THE SPECIFICATION:

At page one, after the title and prior to line 5, please insert the following new paragraph and headings:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the U.S. National Stage of International Application Number PCT/IB2002/004162 filed in the International Bureau on October 10, 2002 and published in English on April 22, 2004 under International Publication Number WO 2004/034733 A1.

BACKGROUND OF THE INVENTION

1. Technical Field

At page 1, prior to line 10, please add the following new heading:

2. Discussion of Related Art

At page 1, please amend the paragraphs beginning on line 19 through page 2, line 27 as follows:

The human organ of hearing, i.e. in simplified language denoted as both ears of a human being, is able to receive and recognize sound waves in an audible frequency range having a minimal lower limit of approximately 20 Hz and having a maximal upper limit of approximately 20 kHz (approximately 18 kHz for adults). The bandwidth of transducers should cover as well as possible the aforementioned perceptible frequency range. Additionally, the acoustic power of transducers, i.e. the

sound pressure level, should be as constant as possible over the complete perceptible frequency range such that sound signal reproduction is as close as possible to the original sound signal.

These requirements have been reached in traditional loudspeaker systems including several transducers each for reproducing partial individual frequency sections being adapted to each other such that the complete audible frequency range is covered. The ~~relative~~relatively large ~~seize~~size of the several transducers as well as a large sized enclosure housing the several transducers contribute to the high sound level capability being substantially constant over the complete audible frequency range. Conventionally, the spacious interior of such a loudspeaker system enclosure is used as resonance room resulting in a resonance amplification within certain acoustic windows (i.e. certain frequency sections).

In case of a single transducer and especially a single transducer having a ~~relative~~relatively small size the aforementioned requirements are still problematic to overcome. Small sized transducers and sound generating devices being based on small sized transducers shall denote devices to be integrated in portable devices allowing only small dimensioned components. Consequently, these sound generating devices have also to cover as broad as possible the audible frequency range (i.e. the bandwidth) with a suitable sound pressure level over the audible frequency range although the exciting surface for sound waves is relative small and resonance amplification which can compensate deficiencies in the sound pressure level at certain frequency sections is limited due to limited available resonance space and limited overall enclosure.

The implementing of multi-media features in mobile phone such as polyphonic alarm signals involving the reproducing of multi-channeled sound, music reproduction and overall improved sound and voice reproduction for example in conjunction with free-hand operation of the mobile phones is gaining a higher status for the purchasers of the mobile phones. But especially the sound generating

apparatus implemented in today's mobile phones lack ~~of~~ the desired reproduction quality.

Furthermore, the harmonization of these two main concerns, i.e. the reproducing of ringing and/or alert tone signals and the play-back of music, is also difficult to achieve because the ringing and/or alert tone signals are preferably within a frequency range to which the human organ of hearing is most sensitive, that is, a frequency range between approximately 2 kHz to 7 kHz, and more particularly a frequency range of approximately 2 kHz to 3 kHz is of importance for generating clearly perceptible ringing and/or alert tone signals. Acoustic resonances within this most sensitive frequency range of human hearing allow for meeting this requirements. The play-back of music requires a more ~~flatten~~flattened and a more natural timbre frequency response of the sound generating apparatus, respectively.

At page 2, line 28, please add the following new heading.

BRIEF SUMMARY OF THE INVENTION

At page 3, please amend the paragraph beginning on line 1 through line 16 as follows:

According to an embodiment of the invention, a sound generating apparatus is provided. The apparatus comprises a first cavity, a second cavity and an electro-mechanical transducer. The electro-mechanical transducer is employed to excite sound waves in the first cavity and in the second cavity. A further third cavity is additional comprised in the apparatus. This third cavity is connected to both the first cavity and the second cavity via a first passage and a second passage both being of individual pre-defined shape and dimensions. The first passage serves as a sound wave passage allowing sound waves of the first cavity to pass to the third cavity. The

second passage serves as a sound wave passage allowing sound waves of the second cavity to pass to the third cavity. The first passage as well as the second passage are both the only passages allowing sound wave emission from the respective first and second cavity, respectively. These passed through sound waves are mixed (superimposed) in the third cavity and are allowed for passing through one or several outlets for emitting sound into an exterior of the apparatus. The resulting emitted sound waves out of the third ~~cavities~~cavity's sound outlets to the exterior of the apparatus depend on the acoustic properties of all interacting cooperative acoustic components, i.e. at least the acoustic properties of the first cavity in conjunction with the first passage, the second cavity in conjunction with the second passage and the third cavity in conjunction with the outlets.

At page 3, please amend the paragraph beginning on line 26 as follows:

According to an embodiment of the invention, the first cavity has a first volume and the second cavity has an ~~essential~~essentially bigger second volume. The first volume of the first cavity is adapted and designed such that this volume acts as a resonator for mid or high sound frequencies, whereas the second volume of the second cavity is adapted and designed such that this volume acts as a resonator for low sound frequencies

At page 4, please amend the paragraph beginning on line 8 as follows:

According to an embodiment of the invention, a mobile electric device having integrated a sound generating apparatus is provided. The apparatus comprises a first cavity, a second cavity and an electro-mechanical transducer. The electro-mechanical transducer is employed to emit sound waves into the first cavity and the second cavity. A further third cavity is ~~additional~~additionally comprised in the apparatus. This third cavity is connected to both the first cavity and the third cavity

via a first passage and a second passage both being of individual pre-defined shape and dimensions. The first passage serves as a sound waves passage allowing sound waves of the first cavity for passing to the third cavity. The second passage serves as a sound waves passage allowing sound waves of the second cavity for passing to the third cavity. These passed through sound waves are mixed in the third cavity and are allowed for passing through one or several outlets for emitting sound into an exterior of the apparatus.

At page 4, please amend the paragraph beginning on line 24 as follows:

According to an embodiment of the invention, a system for generating sound is provided. The system comprises a first cavity, a second cavity and an electro-mechanical transducer. The electro-mechanical transducer is employed to emit sound waves into the first cavity and the second cavity. A further third cavity is ~~additional comprises~~additionally comprised in the apparatus. This third cavity is connected to both the first cavity and the third cavity via a first passage and a second passage both being of individual pre-defined shape and dimensions. The first passage serves as a sound waves passage allowing sound waves of the first cavity for passing to the third cavity. The second passage serves as a sound waves passage allowing sound waves of the second cavity for passing to the third cavity. These passed through sound waves are mixed in the third cavity and are allowed for passing through one or several outlets for emitting sound into an exterior of the system.

At page 5, please add the following new heading and amend the paragraph beginning on line 5 as follows:

BRIEF DESCRIPTION OF THE DRAWINGS

~~It~~The invention will be described in greater detail by means of embodiments with reference to the accompanying drawings, in which

At page 5, line 24, please add the following new heading:

DETAILED DESCRIPTION OF THE INVENTION

At page 5, please amend the paragraphs beginning on line 33 through page 6, line 6 as follows:

Fig. 1 shows an electro-acoustic model illustrating elements for forming a sound generating device according to an embodiment of the invention. The illustrated model comprises a first cavity 110, a transducer 100 and a second cavity 120. The transducer 110 directly excites acoustic waves within the first cavity 110 and the second cavity 120. The excited acoustic waves within the first cavity 110 and the second cavity 120 are coupled into a third cavity 130 via a first passage 115 and a second passage 125 allowing for mixing these acoustic ~~waves ,~~waves, thereby generating superimposed acoustic waves to be radiated into the exterior via outlets 150._The acoustic coupling of the depicted elements is illustrated by acoustic coupling paths depicted as double lines as for example the acoustic coupling path 180 coupling acoustically the second cavity 120 to the second passage 125 and finally to the third cavity 130. An acoustic coupling may be understood as ~~an coupling~~a coupling and decoupling of energy, herein acoustic energy, respectively.

At page 6, please amend the paragraphs beginning on line 18 through page 8, line 11 as follows:

Further conventionally, transducers have a main excitation direction 185 (see Fig. 2a for the main sound emitting direction 185), i.e. a dedicated direction in which sound waves are mainly emitted and in which the emitted sound waves have the highest

average sound pressure level. The surface of a transducer from which the main emitting direction 185 of the transducer extends will be denoted in the following as the front surface of the transducer, whereas the opposite direction to the main emitting direction 185 will be denoted in the following as a supplementary direction 190 being correspondingly associated with a back surface of the transducer.

The first cavity 110 and/or the second cavity 120 serve as acoustic resonators having different resonance characteristics for amplifying the sound pressure level in certain different frequency sections. Resonance amplifying is especially employed in frequency sections in which sound generating (exciting) devices, i.e. transducers, are inefficient, i.e. generate low frequency signals with ~~low~~a low sound pressure level, or when it is desired to rise the sound pressure level in one or frequency sections. Especially, small transducers, i.e. transducers employing a small interacting surface for exciting acoustic waves, i.e. relative to the ~~wave length~~wavelength of the excited acoustic waves, offer ~~a less~~less yield especially in low frequency sections. Particularly, the second cavity 120 serves as an acoustic resonator for amplifying low acoustic frequencies in conjunction with the second passage 125. The acoustic properties of both the second cavity 120 and the second passage 125 contribute to the resulting resonance amplification.

The acoustic properties of the cooperating second cavity 120 and the second passage 125 resulting in the acoustic behavior of this arrangement are determined among other things by a physical volume/dimensions of the second cavity 120 and a design or construction of the second passage 125, respectively, without making demands on completeness. Further, as aforementioned the transducer 100 of the sound generating device according to an embodiment of the invention excites directly both the first cavity 110 and the second cavity 120, wherein the second cavity 120 is designed in such a way that acoustic ~~short-cutting~~shortcutting to the second cavity 120 of that part (surface) of the transducer 100 emitting sound wave radiation into the first cavity 110 is prevented which may otherwise result in a low emitting efficiency. The design of the second cavity 120 is constructed in such a way that the stiffness of the

air therein is reduced to enhance the low frequency efficiency and to form a resonator allowing for resonance amplifying with a corresponding suitable frequency range. These conditions can be attained by designing a second cavity 120 having a significant larger volume than the volume of the first cavity 110. Particularly, the volume of the second cavity 120 is larger by one or more magnitudes in comparison to the volume of the first cavity 110.

As aforementioned, the resonance amplification is a cooperative effect depending on the acoustic properties of both the second cavity 120 and the second passage 125 and their interaction. Besides this resonance ~~amplification~~amplification, further mixing effects occurring in the third cavity 130 have to be taken into consideration ~~at designing~~in designing ~~of~~ the second passage 125. The dimensioning of this second passage 125 has an impact on the characteristics of the sound generating device according to an embodiment of the invention. The length dimensioning of this passage also provides the possibility to control a supplementary phase shift of acoustic waves coming from the second cavity 120 in relation to acoustic waves coming from first cavity 110 both being excited directly by the transducer 100 and being mixed (superimposed) in the third cavity 130. This has the physical effect that acoustic waves with low frequencies from the first cavity 110 and second cavity 120 are added in the mix cavity. If the designing of the second passage 125 is unsuitable, e.g. the length of the second passage 125 is too short, this would result in an unsuitable rise of the lower cut-off frequency. The suitable length dimensioning depends among other things on the volume of the second cavity 120 and the transducer properties.

Moreover, the design of the third cavity 130 and the sound outlets 150 to the outer exterior has also to take consideration of the decoupling of acoustic energy, that is, the energy loss due to acoustic waves ~~emission~~emitted through the second passage 125 from the second cavity 125 to the third cavity 130 and outlets 150. The decoupling of acoustic energy depends on the layout of the second passage 125 and the acoustic properties of the third cavity 130 emitting finally acoustic waves into

the exterior. A decoupling of acoustic energy being too strong, i.e. too high losses due to a small flow-through area of the sound outlets 150 may destroy resonance characteristics of the interacting second cavity 120 and second passage 125 and thus also the aspired to resonance amplification.

The excitation of acoustic waves with frequencies being within the low frequency section by small transducers, i.e. of such a kind employed herein, is less efficient (considerably bad) such that the second passage 125 employed for decoupling of acoustic waves therefrom has to be designed ~~carefully~~carefully, ensuring the ~~preventing~~prevention of the resonance characteristics of the second cavity 120 and the second passage 125. The second passage 125 may be realized as an extended tube-like passage having a pre-defined and adapted cross-sectional area (e.g. diameter) as well as elongated extension (e.g. length).

At page 9, please amend the paragraph beginning on line 16 as follows:

The mixed sound waves in the third cavity 130 originating from the first cavity 110 and the second cavity 120 represents the final complete sound signal to be emitted into the exterior for being heard by a person. The mixture has the desired bandwidth, sound pressure level and frequency performance. The bandwidth of a sound generating apparatus is to be understood as ~~this~~the frequency range within ~~that~~which the frequency dependent sound pressure level is above a certain ~~predefines~~predefined level. A sound reproduction of good quality requires a suitable width of the signal bandwidth, i.e. a suitable lower frequency limit and a upper frequency limit.

At page 10, please amend the paragraph beginning on line 1 as follows:

According to an embodiment of the invention, a dust shielding 140, for example as shown in Figs 2a and 2c embodied as a dust net having a predefined fabric structure particularly adapted to the acoustic properties of the sound generating device, separates the interior of the third cavity 130 from the exterior environment. The dust shielding 140 may prevent dust from penetrating into the third cavity since dust and other dirt particles may have influence on the sound characteristics of the cavities and interfere the above described frequency matching of the cavities. The shielding 140 can be arranged in the third cavity such that the outlets are covered by the shielding wherein the shielding may be close to the outlets or may be spaced with a predefined distance from the outlets. The shielding 140 may be made of plastic foam, fabric and the like.

At page 10, please amend the paragraph beginning on line 21 as follows:

It shall be noted that in order to obtain improved resulting sound characteristics in case of employing a small sized transducer 100 the low frequency amplification achieved by the low frequency resonance adaptation of the second cavity 120 and/or the second passage between second and third cavities 120 and 130. The generation of mid and high frequencies can be achieved by small sized transducers 100 in a suitable and acceptable way also without requiring resonance adaptation of the first ~~cavity. 110~~cavity 110. Nevertheless, the provided arrangement comprising a first, a second and a third cavities 110, 120 and 130 is necessary in order to mix sound of low frequencies from the second cavity 120 to the sound of mid and high frequencies from the first cavity 110 without interfering with the sound characteristics in the first cavity 110 as also in the second cavity 120.

At page 11, please amend the paragraphs beginning at line 1 through line 20 as follows:

As described with respect to the schematic model referred in Fig. 1 the embodiment shown in Fig. 2a depicts a first cavity 110, a second cavity 120, a third cavity 130 and a transducer 100. The cavities 110, 120 and 130 are arranged adjacent to each other in a total volume optimizing way. The cavities 110, 120 and 130 and the transducer 100 are jointly housed in a common enclosure such as an enclosure indicated by the dashed enclosure contour 170. The first cavity 110 and second cavity 120 are spatially separated by the transducer 100. The transducer 100 emits sound waves along its main exciting direction 185 directly into the first cavity 110 (i.e. also denoted as front sound emission) whereas it emits sound waves along its supplementary exciting direction 190 directly into the second cavity 120 (i.e. also denoted as back sound emission). For example, in case the transducer 100 is a loudspeaker having a vibrating membrane for exciting sound waves this membrane separates both the first cavity 110 and the second cavity 120 such that each cavity 110 and 120 ~~have~~has its own resonance characteristics.

The embodied back sound emission is used to excite sound waves in the second cavity 120 having low resonance frequencies, operating as a bass amplifying cavity. The damping of low frequencies is smaller than the damping of higher frequencies such that the back sound emission for exciting the second cavity is suitable and efficient. The first cavity 110 has mid or high resonance frequencies, operating as a mid or high pitch amplifying cavity. Since the damping of the corresponding frequencies is higher ~~a~~ the direct exciting of the first cavity 110 guarantees proper amplifying operation.

At page 11, please amend the paragraph beginning on line 32 as follows:

The following ~~Fig.~~Figs. 2b and 2c show a second cross-sectional view and a third cross-sectional view of a sound generating apparatus according to an embodiment of the invention.

At page 12, please amend the paragraph beginning on line 15 as follows:

In case of a three dimensional depiction of Fig. 2c the illustrated view may disclose the wave exciting surface of the transducer 100 which is indicated by squared filling of the illustration of the first cavity 110. In case that the transducer 100 is a loudspeaker the exciting surface is its vibratable membrane excited ~~to~~to be vibrated by the means of an electro-magnetic excitation system.

At page 12, please amend the paragraph beginning on line 35 through page 13 line 5 as follows:

As aforementioned, the acoustic properties of the system are based on cooperative effects of the cavities 110, 120 and 130 and their passages 115, 125 and the one or more outlets 150, respectively. The following Fig. 3a and Fig. 3b depict each two frequency response curves one being based on an embodiment of the sound generating device according to the invention and the other being based ~~one a~~on a modified embodiment of the sound generating device. The frequency response curves allow ~~to demonstrate and discuss~~a more detailed demonstration and discussion of the cooperative interacting of the cavities and/or passages of the sound generating device according the a respective embodiment of the invention.

At page 14, please amend the paragraphs beginning on line 10 through line 24 as follows:

The third frequency range 302 covers a further resonance peak resulting from the acoustic properties of the first cavity 110 in conjunction with the acoustic properties of the first passage 115 or the slit having a predefined cross-sectional area, respectively. In case of the first resonance curve 310 the resonance peak is in the range of approximately 3 kHz, whereas in case of the second resonance curve 320

the resonance peak is in the range of approximately ~~3,5 kHz~~3.5 kHz. The existence of the third cavity 130 causes that frequencies of the first cavity resonance peak are shifted to lower frequencies analogously to the transducer main resonance peak.

The fourth frequency range 303 covers a further resonance peak resulting from the acoustic properties of the third cavity 130 in conjunction with the acoustic properties of the sound outlets 150 providing a predefined total cross-sectional area. In case of the first resonance curve 310 no corresponding resonance peak occurs in the plot since the embodiment of the sound generating device in accordance to which the measurement of the frequency response curve 310 has been taken includes no corresponding third cavity 130 and no corresponding outlets 150. In case of the second resonance curve 320 the resonance peak is in the range of approximately ~~6,7 kHz~~6.7 kHz.

At page 15, please amend the paragraph beginning on line 9 as follows:

The first frequency range 300 covers a point of inflexion in the third frequency response curve 330 being not present in the fourth frequency response curve 340. As aforementioned this point of inflexion is caused by an acoustic resonance amplification peak being substantially in the same frequency range and analogously resulting from the acoustic properties of the second cavity 120 in conjunction with the second passage 125 (the vent). Since the embodiment from which the fourth frequency response curve 340 is taken has not implemented a second passage 125 (a vent), correspondingly this acoustic resonance peak ~~lacks~~is lacking.

At page 16, please amend the paragraphs beginning on line 9 through line 28 as follows:

Conclusively, three supplementary acoustic resonance areas are present in the frequency response curve of a sound generating device according to an embodiment of the invention. A low frequency resonance amplifies and extends the frequency response of the transducer to lower frequencies. This low frequency resonance results from the second cavity 120 in combination with the second passage 125 and from the being phase adaptation emerging from a suitable design of the second passage 125. A first cavity acoustic resonance resulting from the acoustic properties of the first cavity 110 in combination with the first passage 115 and a third cavity acoustic resonance resulting from the acoustic properties of the third cavity 130 in combination with the outlets 150 extends the frequency response of the transducer to higher frequencies, wherein the third cavity acoustic resonance (at frequencies about 3 kHz) is above the first cavity acoustic resonance (at frequencies about ~~6,5 kHz~~6.5 kHz).

Fig. 4 shows a mobile electric device having implemented a sound generating apparatus according to an embodiment of the invention. Sound outputting components (Fig. 4 illustrates several outlets 150 of such an sound outputting components) according to an embodiment of the sound generating apparatus with respect to the invention are advantageously suitable and applicable in all ~~deices~~devices requiring a sound outputting device and particular in devices of limited size such as portable and mobile electric device 200. A ~~broard~~broad number of possible portable and mobile electric devices 200 ~~implements~~can implement sound outputting components, especially multi-media enabled devices require sound outputting components emitting sound of enhanced quality.

At page 16, please amend the paragraphs beginning on line 36 through page 17 line 23 as follows:

Particularly, cellular phones are suitable target for implementation. Cellular phones of the current generation implement more and more multi-media features, like

electronic music players (MP3 players, AAC players, or related standards), electronic video players (MPEG players or related standards) and also polyphonic alarm tones (ringing tones). All these features will be improved in their use in case of an implemented sound generating component of enhanced quality since not all users wish to carry headphones or it is desired to reproduce audible sound ~~audible~~ simultaneously ~~by a~~to a group of users e.g. in a hand-free operation mode.

But also in view of coming standards offering high data rates the number and the usage of music and video streaming applications will rise. ~~Besides~~Compared to the optical reproducing quality which can now be achieved ~~yet~~ with available ~~displays~~displays, the reproducing quality of sound is today of minor quality such that headphones are the only solution up to now. The sound generating apparatus, components or systems according to an embodiment of the present invention overcome the minor sound reproducing quality which will also be a quality enhancement in conjunction with a simple phone call, i.e. the reproduction of voices and transmitted speech will be also improved.

The electric device having implemented a sound generating apparatus according to an embodiment of the invention may partially ~~dictated~~dictate dimensioning of the implemented sound generating apparatus. Especially the mostly limited housing of the electric device defines the outer dimensions of the sound generating apparatus, wherein a part of the housing of the electric device may act simultaneously as one or more parts of one or more of the several cavities and further acoustic components of the sound generating apparatus. Correspondingly, the dimensioning of the cavities and their connecting passages have to be adapted to the outer housing of the electric device, wherein the dimensioning of the connecting passages has to be adapted to the volume of the cavities and the desired acoustic resonance amplifications.

At page 18, please amend the paragraph beginning on line 5 as follows:

It will be ~~obvious for those~~evident to anyone skilled in the art that as the technology advances, the inventive concept can be implemented in a different and broader number of ways. The invention and its embodiments are thus not limited to the examples described above but may vary within the scope of the claims.